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JAMES AS A PHILOSOPHER[1]

FIFTY years since, if competent judges were asked to name the American thinkers from whom there had come novel and notable and typical contributions to general philosophy, they could in reply mention only two men—Jonathan Edwards and Ralph Waldo Emerson. For the conditions that determine a fair answer to the question, "Who are your representative American philosophers?" are obvious. The philosopher who can fitly represent the contribution of his nation to the world's treasury of philosophical ideas, must first be one who thinks for himself, fruitfully, with true independence, and with successful inventiveness, about problems of philosophy. And, secondly, he must be a man who gives utterance to philosophical ideas which are characteristic of some stage and of some aspect of the spiritual life of his own people. In Edwards and in Emerson, and only in these men, had these two conditions found their fulfilment, so far as our American civilization had yet expressed itself in the years that had preceded our civil war. Edwards, in his day, made articulate some of the great interests that had moulded our early religious life. The thoughts which he most discussed were indeed, in a sense, old, since they largely concerned a traditional theology. Yet both in theology and general philosophy, Edwards was an originator. For he actually rediscovered some of the world's profoundest ideas

[1] Oration delivered on June 29 at the annual exercises of the Harvard Chapter of Phi Beta Kappa.

regarding God and humanity simply by reading for himself the meaning of his own religious experience., With a mysterious power of philosophical intuition, even in his early youth, he observed what, upon the basis of what we know to have been his range of philosophical reading, we could not possibly have expected him to observe. If the sectarian theological creed that he defended was to our minds narrow, what he himself saw was very far-reaching and profound. For he viewed religious problems with synoptic vision that enabled him to reconcile, in his own personal way, some of the greatest and most tragic conflicts of the spiritual world, and what he had to say consequently far transcended the interests of the special theological issues which he discussed. Meanwhile, he spoke not merely as a thinker, but as one who gave voice to some of the central motives and interests of our colonial religious life. Therefore he was, in order of time the first of our nationally representative philosophers.

Another stage of our civilization—a later phase of our national ideals—found its representative in Emerson. He too was in close touch with many of the world's deepest thoughts concerning ultimate problems. Some of the ideas that most influenced him have their far-off historical origins in oriental as well as in Greek thought, and also their nearer foreign sources in modern European philosophy. But he transformed whatever he assimilated. He invented upon the basis of his personal experience, and so he was himself no disciple of the orient, or of Greece, still less of England and of Germany. He thought, felt and spoke as an American.

Fifty years ago, I say, our nation had so far found these two men to express each his own stage of the philosophy of our national civilization. The essence of a philosophy, in case you look at it solely from a historical point of view, always appears to you thus: A great philosophy expresses an interpretation of the life of man and a view of the universe, which is at once personal, and if the thinker is representative of his people, national in its significance. Edwards and Emerson had given tongue to the meaning of two different stages of our American culture. And these were thus far our only philosophical voices.

To-day, if we ask any competent foreign critic of our philosophy whether there is any other name to be added to these two classic American philosophers, we shall receive the unanimous answer: "There is to-day a third representative American philosopher. His name is William James." For James meets the two conditions just mentioned. He has thought for himself, fruitfully, with true independence, and with successful inventiveness. And he has given utterance to ideas which are characteristic of a stage and of an aspect of the spiritual life of this people. He, too, has been widely and deeply affected by the history of thought. But he has reinterpreted all these historical influences in his own personal way. He has transformed whatever he has assimilated. He has rediscovered whatever he has received from without; because he never could teach what he had not himself experienced. And, in addition, he has indeed invented effectively and richly. Moreover, in him certain characteristic aspects of our national civilization have found their voice. He is thus the third in the order of time among our representative American philosophers. Already, within a year of his death, he has begun to acquire something of a classic rank and dignity. In future this rank and dignity will long increase. In one of

James's latest utterances he indeed expressed, with characteristic energy, a certain abhorrence of what he called classical tendencies in philosophical thought. But I must repeat the word: Fortune not unjustly replies, and will reply to James's vigorous protest against every form of classicism, by making him a classic.

Thus, then, from the point of view of the competent foreign students of our philosophy, the representative American philosophers are now three and only three —Edwards, Emerson, James.

And of these three there can be little question that, at the present time, the most widely known abroad is James. Emerson has indeed found a secure place in the minds of the English-speaking lovers of his type of thought everywhere; and has had an important part in the growth of some modern German tendencies. But James has already won, in the minds of French, of German, of Italian, and of still other groups of foreign readers, a position which gives him a much more extended range of present influence than Emerson has ever possessed.

It is my purpose, upon the present occasion, to make a few comments upon the significance of William James's philosophy. This is no place for the discussion of technical matters. Least of all have I any wish to undertake to decide, upon this occasion, any controversial issues. My intentions as I address you are determined by very simple and obvious considerations. William James was my friend from my youth to the end of his beneficent life. I was once for a brief time his pupil. I long loved to think of myself as his disciple; although perhaps I was always a very bad disciple. But now he has just left us. And as I address you I remember that he was your friend also. Since the last annual meeting of this assembly he has been lost to us all. It is fitting that we should recall his memory to-day. Of personal reminiscences, of biographical sketches, and of discussions relating to many details of his philosophy, the literature that has gathered about his name during the few months since we lost him, has been very full. But just as this is no occasion for technical discussion of his philosophy so too I think this is no place to add new items to the literature of purely personal reminiscence and estimate of James. What I shall try to do is this: I have said that James is an American philosopher of classic rank, because he stands for a stage in our national self-consciousness—for a stage with which historians of our national mind must always reckon. This statement, if you will permit, shall be my text. I shall devote myself to expounding this text as well as I can in my brief time, and to estimating the significance of the stage in question, and of James's thought in so far as it seems to me to express the ideas and the ideals characteristic of this phase of our national life.

I

In defining the historical position which William James, as a thinker, occupies, we have of course to take account, not only of national tendencies, but also of the general interests of the world's thought in his time. William James began his work as a philosopher, during the seventies of the last century, in years which were, for our present purpose, characterized by two notable movements of world-wide significance. These two movements were at once scientific in the more special sense of that term, and philosophical in the broad meaning of that word. The first of the movements was concerned with the elaboration—the widening and the deepening of the newer doctrines about evolution. This movement

had indeed been preceded by another. The recent forms of evolutionary doctrine, those associated with the names of Darwin and of Spencer, had begun rapidly to come into prominence about 1860. And the decade from 1860 to 1870, taken together with the opening years of the next decade, had constituted what you may call the storm and stress period of Darwinism, and of its allied tendencies, such as those which Spencer represented. In those years the younger defenders of the new doctrines so far as they appealed to the general public, fought their battles, declared their faith, out of weakness were made strong and put to flight the armies of the theologians. You might name, as a closing event of that storm and stress period, Tyndall's famous Belfast address of 1874, and the warfare waged about that address. Haeckel's early works, some of Huxley's most noted polemic essays, Lange's "History of Materialism," the first eight or nine editions of Von Hartmann's "Philosophy of the Unconscious," are documents characteristic of the more general philosophical interests of that time. In our country, Fiske's "Cosmic Philosophy" reflected some of the notable features that belonged to these years of the early conquests of evolutionary opinion.

Now in that storm and stress period, James had not yet been before the public. But his published philosophical work began with the outset of the second and more important period of evolutionary thought—the period of the widening and deepening of the new ideas. The leaders of thought who are characteristic of this second period no longer spend their best efforts in polemic in favor of the main ideas of the newer forms of the doctrine of evolution. In certain of its main outlines—outlines now extremely familiar to the public—they simply accept the notion of the natural origin of organic forms and of the general continuity of the processes of development. But they are concerned, more and more, as time goes on, with the deeper meaning of evolution, with the study of its factors, with the application of the new ideas to more and more fields of inquiry, and, in case they are philosophers, with the reinterpretation of philosophical traditions in the light of what had resulted from that time of storm and stress.

James belongs to this great second stage of the evolutionary movement, to the movement of the elaboration, of the widening and deepening of evolutionary thought, as opposed to that early period of the storm and stress. We still live in this second stage of evolutionary movement. James is one of its most inventive philosophical representatives. He hardly ever took part in the polemic in favor of the general evolutionary ideas. Accepting them, he undertook to interpret and apply them.

And now, secondly, the period of James's activity is the period of the rise of the new psychology. The new psychology has stood for many other interests besides those of a technical study of the special sciences of the human and of the animal mind. What is technical about psychology is indeed important enough. But the special scientific study of mind by the modern methods used in such study has been a phase and a symptom of a very much larger movement—a movement closely connected with all that is most vital in recent civilization, with all the modern forms of nationalism, of internationalism, of socialism, and of individualism. Human life has been complicated by so many new personal and social problems, that man has needed to aim, by whatever means are possible, towards a much more

elaborate knowledge of his fellow-man than was ever possible before. The results of this disposition appear in the most widely diverse sciences and arts. Archeology and ethnology, history and the various social sciences, dramatic art, the novel, as well as what has been called psychical research —in a word, all means, good and bad, that have promised either a better knowledge of what man is or a better way of portraying what knowledge of man one may possess—have been tried and moulded in recent times by the spirit of which recent technical psychology is also an expression. The psychological movement means then something that far transcends the interests of the group of sciences to which the name psychology now applies. And this movement assumed some of its most important recent forms during the decade in which James began to publish his work. His own contributions to psychology reflect something of the manifoldness and of the breadth of the general psychological movement itself. If he published the two great volumes entitled "Psychology" he also wrote "The Varieties of Religious Experience," and he played his part in what is called "psychical research."

These then are James's two principal offices when you consider him merely in his most general relations to the thought of the world at large in his time. He helped in the work of elaborating and interpreting evolutionary thought. He took a commanding part in the psychological movement.

II

But now it is not of these aspects of James's work, significant as they are, that I have here especially to speak. I must indeed thus name and emphasize these wider relations of his thought to the world's contemporary thought. But I do so in order to give the fitting frame to our picture. I now have to call attention to the features about James which make him, with all his universality of interest, a representative American thinker. Viewed as an American, he belongs to the movement which has been the consequence first, of our civil war, and secondly, of the recent expansion, enrichment, and entanglement of our social life. He belongs to the age in which our nation, rapidly transformed by the occupation of new territory, by economic growth, by immigration and by education, has been attempting to find itself anew, to redefine its ideals, to retain its moral integrity, and yet to become a world power. In this stage of our national consciousness we still live and shall plainly have to live for a long time in the future. The problems involved in such a civilization we none of us well understand; least of all do I myself understand them. And James, scholar, thinker, teacher, scientific and philosophical writer as he was, has of course only such relation to our national movement as is implied by the office that he thus fulfills. Although he followed with keen interest a great variety of political and social controversies, he avoided public life. Hence he was not absorbed by the world of affairs, although he was always ready to engage generously in the discussion of practical reforms. His main office with regard to such matters was therefore that of philosophical interpreter. He helped to enlighten his fellows as to the relations between the practical problems of our civilization and those two world-wide movements of thought of which I have just spoken.

Let me call attention to some of the results of James's work as interpreter of the problems of the American people. I need not say that this work was, to his own mind, mainly incidental to his interest in

those problems of evolutionary thought and of psychology to which I just directed your attention. I am sure that James himself was very little conscious that he was indeed an especially representative American philosopher. He certainly had no ambition to vaunt himself as such. He worked with a beautiful and hearty sincerity upon the problems that as a fact interested him. He knew that he loved these problems because of their intense human interest. He knew, then, that he was indeed laboring in the service of mankind. But he so loved what he called the concrete, the particular, the individual, that he naturally made little attempt to define his office in terms of any social organism, or of any such object as our national life, viewed as an entity. And he especially disliked to talk of causes in the abstract, or of social movements as I am here characterizing them. His world seemed to him to be made up of individuals—men, events, experiences and deeds. And he always very little knew how important he himself was, or what vast inarticulate social forces were finding in him their voice. But we are now viewing James from without, in a way that is of course as imperfect as it is inevitable. We therefore have a right at this point to attribute to him an office that, as I believe, he never attributed to himself.

And here we have to speak first of James's treatment of religious problems, and then of his attitude towards ethics.

Our nation since the civil war has largely lost touch with the older forms of its own religious life. It has been seeking for new embodiments of the religious consciousness, for creeds that shall not be in conflict with the modern man's view of life. It was James's office, as psychologist, and as philosopher, to give a novel expression to this our own national variety of the spirit of religious unrest. And his volume "The Varieties of Religious Experience," is one that, indeed, with all its wealth of illustration, and in its courageous enterprise, has a certain classic beauty. Some men preach new ways of salvation. James simply portrayed the meaning that the old ways of salvation had possessed, or still do possess, in the inner and personal experience of those individuals whom he has called the religious geniuses. And then he undertook to suggest an hypothesis as to what the whole religious process might mean. The hypothesis is on the one hand in touch with certain tendencies of recent psychology. And in so far it seems in harmony with the modern consciousness. On the other hand it expresses, in a way, James's whole philosophy of life. And in this respect it comes into touch with all the central problems of humanity.

The result of this portrayal was indeed magical. The psychologists were aided towards a new tolerance in their study of religion. The evolution of religion appeared in a new light. And meanwhile many of the faithful, who had long been disheartened by the later forms of evolutionary naturalism, took heart anew when they read James's vigorous appeal to the religious experience of the individual as to the most authoritative evidence for religion. "The most modern of thinkers, the evolutionist, the psychologist," they said, "the heir of all the ages, has thus vindicated anew the witness of the spirit in the heart—the very source of inspiration in which we ourselves have always believed." And such readers went away rejoicing, and some of them even began to write christologies based upon the doctrine of James as they understood it. The new gospel, the glad tidings of the subconscious, began to be preached in many

lands. It has even received the signal honor of an official papal condemnation.

For my own part, I have ventured to say elsewhere that the new doctrine, viewed in one aspect, seems to leave religion in the comparatively trivial position of a play with whimsical powers—a prey to endless psychological caprices. But James's own robust faith was that the very caprices of the spirit are the opportunity for the building-up of the highest forms of the spiritual life; that the unconventional and the individual in religious experience are the means whereby the truth of a superhuman world may become most manifest. And this robust faith of James, I say, whatever you may think of its merits, is as American in type as it has already proved effective in the expression which James gave to it. It is the spirit of the frontiersman, of the gold seeker, or the home builder, transferred to the metaphysical and to the religious realm. There is our far-off home, our long-lost spiritual fortune. Experience alone can guide us towards the place where these things are; hence you indeed need experience. You can only win your way on the frontier in case you are willing to live there. Be, therefore, concrete, be fearless, be experimental. But, above all, let not your abstract conceptions, even if you call them scientific conceptions, pretend to set any limits to the richness of spiritual grace, to the glories of spiritual possession, that, in case you are duly favored, your personal experience may reveal to you. James reckons that the tribulations with which abstract scientific theories have beset our present age are not to be compared with the glory that perchance shall be, if only we open our eyes to what experience itself has to reveal to us.

In the quest for the witness to whom James appeals when he tests his religious doctrine, he indeed searches the most varied literature; and of course most of the records that he consults belong to foreign lands. But the book called "The Varieties of Religious Experience" is full of the spirt that, in our country, has long been effective in the formation of new religious sects; and this volume expresses, better than any sectarian could express, the recent efforts of this spirit to come to an understanding with modern naturalism, and with the new psychology. James's view of religious experience is meanwhile at once deliberately unconventional and intensely democratic. The old world types of reverence for the external forms of the church find no place in his pages; but equally foreign to his mind is that barren hostility of the typical European free thinkers for the church with whose traditions they have broken. In James's eyes, the forms, the external organizations of the religious world simply wither; it is the individual that is more and more. And James, with a democratic contempt for social appearances, seeks his religious geniuses everywhere. World-renowned saints of the historic church receive his hearty sympathy; but they stand upon an equal footing, in his esteem, with many an obscure and ignorant revivalist, with faith healers, with poets, with sages, with heretics, with men that wander about in all sorts of sheepskins and goatskins, with chance correspondents of his own, with whomsoever you will of whom the world was not and is not worthy, but who, by inner experience, have obtained the substance of things hoped for, the evidence of things not seen.

You see, of course, that I do not believe James's resulting philosophy of religion to be adequate. For as it stands it is indeed chaotic. But I am sure that it can only be amended by taking it up into a larger view,

and not by rejecting it. The spirit triumphs, not by destroying the chaos that James describes, but by brooding upon the face of the deep until the light comes, and with light, order. But I am sure also that we shall always have to reckon with James's view. And I am sure also that only an American thinker could have written this survey, with all its unconventional ardor of appreciation, with all its democratic catholicity of sympathy, with all its freedom both from ecclesiastical formality and from barren free thinking. I am sure also that no book has better expressed the whole spirit of hopeful unrest, of eagerness to be just to the modern view of life, of longing for new experience, which characterizes the recent American religious movement. In James's book then the deeper spirit of our national religious life has found its most manifold and characteristic expression.

III

I must next turn to the other of the two aspects of James's work as a thinker that I mentioned above, namely to his ethical influence. Since the war our transformed and restless people has been seeking not only for religious, but for moral guidance. What are the principles that can show us the course to follow in the often pathless wilderness of the new democracy? It frequently seems as if, in every crisis of our greater social affairs we needed somebody to tell us both our dream and the interpretation thereof. We are eager to have life, and that abundantly. But what life? And by what test shall we know the way of life?

The ethical maxims that most readily meet the popular demand for guidance in such a country, and at such a time, are maxims that combine attractive vagueness with an equally winning pungency. They must seem obviously practical; but must not appear excessively rigorous. They must arouse a large enthusiasm for action, without baffling us with the sense of restraint, or of wearisome self-control. They must not call for extended reflection. Despite their vagueness they must not appear abstract, nor yet hard to grasp. The wayfaring man, though a fool, must be sure that he at least will not err in applying our moral law. Moral blunders must be natural only to opponents, not to ourselves. We must be self-confident. Moreover, our moral law must have an athletic sound. Its first office is to make us "good sports." Only upon such a law can we meditate day and night, in case the "game" leaves us indeed any time for meditation at all. Nevertheless, these popular maxims will of course not be meant as mere expressions of blind impulse. On the contrary, they will appeal to highly intelligent minds, but to minds anxious for relief from the responsibility of being too thoughtful. In order to be easily popular they must be maxims that stir the heart, not precisely indeed like the sound of a trumpet, but more like the call of the horn of an automobile. You will have in mind the watchwords that express some of the popular ethical counsels thus suggested. One of these watchwords has of late enabled us to abbreviate a well-known and surely a highly intelligent maxim, to something that is to-day used almost as a mere injection. It is the watchword, "Efficiency"! Another expression of the same motive takes shape in the equally familiar advice, "Play the game."

Now I do not mean to make light of the real significance of just such moral maxims, for awakening and inspiring just our people in this day. The true value of these maxims lies for us in three of their characteristic features. First, they give us counsel that is in any case opposed

to sloth. And sloth on every level of our development remains one of the most treacherous and mortal enemies of the moral will. Secondly, they teach us to avoid the dangers to which the souls of Hamlet's type fall a prey. That is, they discourage the spirit that reflectively divides the inner self, and that leaves it divided. They warn us that the divided self is indeed, unless it can heal its deadly wound, by fitting action, a lost soul. And thirdly, they emphasize courage. And courage—not, to be sure, so much the courage that faces one's rivals in the market place, or one's foes on the battlefield as the courage that fits us to meet our true spiritual enemies—the courage that arises anew from despair and that undertakes, despite all tribulations, to overcome the world—such courage is one of the central treasures of the moral life.

Because of these three features, the maxims to which I refer are in all their vagueness, vehicles of wisdom. But they express themselves in their most popular forms with a wilfulness that is often more or less comic, and that is sometimes tragic. For what they do not emphasize is the significance of self-possession, of lifting up our eyes to the hills whence cometh our help, of testing the life that now is by the vision of the largest life that we can in ideal appreciate. These popular maxims also emphasize results rather than ideals, strength rather than cultivation, temporary success rather than wholeness of life, the greatness of "Him that taketh a city," rather than of "Him that ruleth his spirit." They are the maxims of unrest, of impatience and of a certain humane and generous unscrupulousness, as fascinating as it is dangerous. They characterize a people that is indeed earnestly determined to find itself, but that so far has not found itself.

Now one of the most momentous problems regarding the influence of James is presented by the question: How did he stand related to these recent ethical tendencies of our nation? I may say at once that, in my opinion, he has just here proved himself to be most of all and in the best sense our national philosopher. For the philosopher must not be an echo. He must interpret. He must know us better than we know ourselves, and this is what indeed James has done for our American moral consciousness. For, first, while he indeed made very little of the formal office of an ethical teacher and seldom wrote upon technical ethical controversies, he was, as a fact, profoundly ethical in his whole influence. And next, he fully understood, yes shared in a rich measure, the motives to which the ethical maxims just summarized have given expression. Was not he himself restlessly active in his whole temperament? Did he not love individual enterprise and its free expression? Did he not loathe what seemed to him abstractions? Did he not insist that the moralist must be in close touch with concrete life? As psychologist did he not emphasize the fact that the very essence of conscious life lies in its active, yes, in its creative relation to experience? Did he not counsel the strenuous attitude towards our tasks? And are not all these features in harmony with the spirit from which the athletic type of morality just sketched seems to have sprung?

Not only is all this true of James, but, in the popular opinion of the moment, the doctrine called pragmatism, as he expounded it in his Lowell lectures, seems, to many of his foreign critics, and to some of those who think themselves his best followers here at home, a doctrine primarily ethical in its force, while, to some minds, pragmatism seems also to be a sort of phi-

losophical generalization of the efficiency doctrine just mentioned. To be sure, any closer reader of James's "Pragmatism" ought to see that his true interests in the philosophy of life are far deeper than those which the maxims "Be efficient," and, "Play the game" mostly emphasize. And, for the rest, the book on pragmatism is explicitly the portrayal of a method of philosophical inquiry, and is only incidentally a discourse upon ethically interesting matters. James himself used to protest vigorously against the readers who ventured to require of the pragmatist viewed simply as such, any one ethical doctrine whatever. In his book on "Pragmatism" he had expounded, as he often said, a method of philosophizing, a definition of truth, a criterion for interpreting and testing theories. He was not there concerned with ethics. A pragmatist was free to decide moral issues as he chose, so long as he used the pragmatic method in doing so, that is, so long as he tested ethical doctrines by their concrete results, when they were applied to life.

Inevitably, however, the pragmatic doctrine that both the meaning and the truth of ideas shall be tested by their empirical consequences of these ideas and by the practical results of acting them out in life, has seemed both to many of James's original hearers, and to some of the foreign critics just mentioned, a doctrine that is simply a characteristic Americanism in philosophy—a tendency to judge all ideals by their practical efficiency, by their visible results, by their so-called "cash values."

James, as I have said, earnestly protested against this cruder interpretation of his teaching. The author of "The Varieties of Religious Experience" and of the "Pluralistic Universe" was indeed an empiricist, a lover of the concrete and a man who looked forward to the future rather than backward to the past; but despite his own use, in his "Pragmatism" of the famous metaphor of the "cash values" of ideas, he was certainly not a thinker who had set his affections upon things below rather than upon things above. And the "consequences" upon which he laid stress when he talked of the pragmatic test for ideas, were certainly not the merely worldly consequences of such ideas in the usual sense of the word "worldly." He appealed always to experience; but then for him, experience might be, and sometimes was, religious experience—experience of the unseen and of the superhuman. And so James was right in his protest against these critics of his later doctrine. His form of pragmatism was indeed a form of Americanism in philosophy. And he too had his fondness for what he regarded as efficiency, and for those who "play the game," whenever the game was one that he honored. But he also loved too much those who are weak in the eyes of this present world—the religious geniuses, the unpopular inquirers, the noble outcasts. He loved them, I say, too much to be the dupe of the cruder forms of our now popular efficiency doctrine. In order to win James's most enthusiastic support, ideas and men needed to express an intense inner experience along with a certain unpopularity which showed that they deserved sympathy. Too much worldly success, on the part of men or of ideas, easily alienated him. Unworldliness was one of the surest marks, in his eyes, of spiritual power, if only such unworldliness seemed to him to be joined with interests that, using his favorite words, he could call "concrete" and "important."

In the light of such facts, all that he said about judging ideas by their "consequences" must be interpreted, and there-

fore it is indeed unjust to confound pragmatism with the cruder worship of efficiency.

IV

Yet, I repeat, James's philosophy of life was indeed, in its ethical aspects, an expression of the better spirit of our people. He understood, he shared, and he also transcended the American spirit. And just that is what most marks him as our national philosopher. If you want to estimate his philosophy of life in its best form, you must read or re-read, not the "Pragmatism," but the essays contained in the volume entitled "The Will to Believe."

May I still venture, as I close, to mention a few features of the doctrine that is embodied in that volume? The main question repeatedly considered in these essays of James is explicitly the question of an empiricist, of a man averse to abstractions, and of an essentially democratic thinker, who does not believe that any final formulation of an ideal of human life is possible until the last man has had his experience of life, and has uttered his word. But this empiricism of the author is meanwhile the empiricism of one who especially emphasizes the central importance of the active life as the basis of our interpretation of experience. Herein James differs from all traditional positivists. Experience is never yours merely as it comes to you. Facts are never mere data. They are data to which you respond. Your experience is constantly transformed by your deeds. That this should be the case is determined by the most essential characteristics of your consciousness. James asserts this latter thesis as psychologist, and has behind him, as he writes, the vast mass of evidence that his two psychological volumes present. The simplest perception, the most elaborate scientific theory, illustrate how man never merely finds, but also always cooperates in creating his world.

No doubt then life must be estimated and guided with constant reference to experience, to consequences, to actual accomplishments, to what we Americans now call efficiency. But on the other hand efficiency itself is not to be estimated in terms of mere data. Our estimate of our world is not to be forced upon us by any mere inspection of consequences. What makes life worth living is not what you find in it, but what you are ready to put into it by your ideal interpretation of the meaning that, as you insist, it shall possess for you. This ideal meaning is always for you a matter of faith not to be imposed coercively upon another, but also never to be discovered by watching who it is that wins, or by merely feeling your present worldly strength as a player of the game. Your deeper ideals always depend upon viewing life in the light of larger unities than now appear, upon viewing yourself as a co-worker with the universe for the attainment of what no present human game of action can now reveal. For this "radical empiricist" then present experience always points beyond itself to a realm that no human eye has yet seen—an empirical realm of course, but one that you have a right to interpret in terms of a faith that is itself active, but that is not merely worldly and athletic. The philosophy of action thus so imperfectly suggested by the few phrases that I have time to use, can best be interpreted, for the moment, by observing that the influence of Carlyle in many passages of this volume is as obvious as it is by our author independently reinterpreted and transformed. Imagine Carlyle transformed into a representative American thinker, trained as a naturalist, deeply versed in psychology, deprived of his disposition to hatred, open-minded towards

the interests of all sorts and conditions of men, still a hero worshiper, but one whose heroes could be found in the obscurest lovers of the ideal as easily as in the most renowned historical characters; let this transformed Carlyle preach the doctrine of the resolute spirit triumphant through creative action, defiant of every degree of mortal suffering. Let him proclaim "The Everlasting Yea" in the face of all the doubts of erring human opinion: and herewith you gain some general impression of the relations that exist between "Sartor Resartus" and "The Will to Believe."

The ethical maxims which are scattered through these pages voluntarily share much of the vagueness of our age of tentative ethical effort. But they certainly are not the maxims of an impressionist, of a romanticist, or of a partisan of merely worldly efficiency. They win their way through all such attitudes to something beyond—to a resolute interpretation of human life as an opportunity to cooperate with the superhuman and the divine. And they do this, in the author's opinion, not by destroying, but by fulfilling the purposes and methods of the sciences of experience themselves. Is not every scientific theory a conceptual reinterpretation of our fragmentary perceptions, an active reconstruction, to be tried in the service of a larger life? Is not our trust in a scientific theory itself an act of faith? Moreover, these ethical maxims are here governed, in James's exposition, by the repeated recognition of certain essentially absolute truths, truths that, despite his natural horror of absolutism, he here expounds with a finished dialectic skill that he himself, especially in his later polemic period, never seemed to prize at its full value. The need of active faith in the unseen and the superhuman he founds upon these simple and yet absolutely true principles, principles of the true dialectics of life: First, every great decision of practical life requires faith, and has irrevocable consequences, consequences that belong to the whole great world, and that therefore have endless possible importance. Secondly, since action and belief are thus inseparably bound together, our right to believe depends upon our right, as active beings, to make decisions. Thirdly, our duty to decide life's greater issues is determined by the absolute truth that, in critical cases, the will to be doubtful and not to decide, is itself a decision, and is hence no escape from our responsible moral position. And this our responsible position is a position that gives us our place in and for all future life. The world needs our deeds. We need to interpret the world in order to act. We have a right to interpret the universe so as to enable us to act at once decisively, courageously and with the sense of the inestimable preciousness and responsibility of the power to act.

In consequence of all these features of his ethical doctrine a wonderful sense of the deep seriousness and of the possibly divine significance of every deed is felt in James's every ethical counsel. Thus it is that while fully comprehending the American spirit which we have sketched, he at once expresses it and transforms it. He never loved Fichte; but there is much of the best of the ethical idealism of Fichte in "The Will to Believe." Many of you have enjoyed James's delightfully skilful polemic against Hegel, and against the external forms, phrases and appearances of the later constructive idealists. I have no wish here to attempt to comment upon that polemic; but I can assure you that I myself learned a great part of my own form of absolute idealism from the earliest expressions that James gave to the thoughts contained in "The Will to Believe." As

one of his latest works, "The Pluralistic Universe," still further showed, he himself was in spirit an ethical idealist to the core. Nor was he nearly so far in spirit even from Hegel as he supposed, guiltless as he was of Hegel's categories. Let a careful reading of the "Pluralistic Universe" make this fact manifest.

Meanwhile, what interests us is that, in "The Will to Believe," as well as in "The Pluralistic Universe," this beautifully manifold, appreciative and humane mind, at once adequately expressed, and, with true moral idealism transcended the caprices of recent American ethics. To this end he lavishly used the resources of the naturalist, of the humanist, and of the ethical dialectician. He saw the facts of human life as they are, and he resolutely lived beyond them into the realm of the spirit. He loved the concrete but he looked above towards the larger realm of universal life. He often made light of the abstract reason, but in his own plastic and active way he uttered some of the great words of the universal reason, and he has helped his people to understand and to put into practise these words.

I ask you to remember him then, not only as the great psychologist, the radical empiricist, the pragmatist, but as the interpreter of the ethical spirit of his time and of his people—the interpreter who has pointed the way beyond the trivialities which he so well understood and transcended towards that "Rule of Reason" which the prophetic maxim of our supreme court has just brought afresh to the attention of our people. That "Rule of Reason," when it comes, will not be a mere collection of abstractions. It will be, as James demanded, something concrete and practical. And it will indeed appeal to our faith as well as to our discursive logical processes. But it will express the transformed and enlightened American spirit as James already began to express it. Let him too be viewed as a prophet of the nation that is to be.

JOSIAH ROYCE

HARVARD UNIVERSITY

HOWELL'S RELIEF MAPS AND THE NATURALISTIC LAND MODEL

THE death of Edwin E. Howell removes one well known among those connected with earth studies in this country, who will be greatly missed.

As stated by Dr. G. K. Gilbert in the May 12th issue of SCIENCE, Howell was the pioneer for the United States in the modeling of relief maps. As his work is the most widely distributed and best known of any in American institutions and has greatly influenced the prevalent conception of the subject, a brief analysis of it may be of interest.

Howell made the best and most ornamental relief maps we have. They were true to the maps which were represented, and were finished and lettered in an exceptionally decorative style. Dr. Gilbert mentions that Howell's work "was not distinguished for its artistic quality." The use of the term "artistic" is frequently misleading. Howell's work certainly showed skillful craftsmanship and "finish." For many years he employed an expert whose lettering was the most elaborate to be found on relief-map work. Dr. Gilbert further states that the work was "realistic wherever the material from which he worked was full." In one instance where a relief containing a breakwater was made, an actual specimen of rock taken from the stone foundation was introduced; this was realism but not "naturalistic," both the scale of detail and the material were not in keeping with the rest of the work.

"Naturalistic" is the term applied to the truthful reproduction of natural topography as distinguished from the conventional or diagrammatic map-method. The most obvious difference in the two classes of work is that the naturalistic gives the appearance as

well as dimensions of the place represented. The naturalistic principle calls for rational procedure throughout, toward the end that the result shall not only reproduce shapes and measurements, but characteristic expression of the land as well. The procedure must be rational according with natural laws, to bring about naturalistic results.

The subject of the representation of the earth's surface in relief is to-day little generally understood. It is one with a dual basis, the earth sciences on one hand, with the principles and application of art on the other. As paleobotany rests on both geology and botany, so the subject of land representation in relief has its rational basis on a knowledge of the lands and the principles and applications of landscape art. Each place chosen for representation in relief is a subject in natural history presenting a problem whose rational solution as such depends upon a comprehensive study of the locality with its meaning and possibilities as representative of earth form, and an adequate treatment as such natural phenomena or landscape, throughout the entire process of modelling and coloring. Simple and reasonable as may be this view little application of it seems to have been made in the land relief work produced in this country. Without a conception of the naturalistic basis as a guide, the mechanical turning of map data into a raised form, however accurate and complete the process may be, is machine-like drudgery. With the naturalistic conception which has been rarely well appreciated by those not versed in the motives of art, the work becomes rational and definite. Each subject under this light is a problem involving natural phenomena, whose adequate solution requires deduction from field observation applied to the special requirements of the work, with due recognition of the established principles of good art.

Relief maps are plentiful, but as yet naturalistic models of land forms are scarce. (In our museums there are few specimens of naturalistic earth models. Neither the government Geological Survey nor the National Museum has yet undertaken or exhibited this class of work. In the United States, geology and geography are to-day practically without natural history specimens of their greater forms.)

Howell was a man whose fortune it was to be little troubled with artistic sensibilities, his work in land relief could be compared to that of an anatomist engaged in making anatomical models, indeed he dealt in this work, and his product played quite the same relation to figure sculpture that relief maps bear to naturalistic models.

Relief maps in the making of which Howell stood at the head, have their place, but they do not fulfill that of the naturalistic model and the two distinct principles of work which each represents need not be confused. The raised or relief map is a form of diagram, a conventional representation of topography made by raising the signs on a map into relief, as indicated by its symbols. It is mechanical and can be largely produced by a machine. In the French military service it is so done. The purpose of the naturalistic model is to represent nature, not maps; it corresponds to figure sculpture and landscape painting, and aims to give not only correct dimensions, but a character and likeness of the special part of the world represented. The raised map is like the engineering diagram, special and very limited in its application. The naturalistic model contains all the data of the relief map and much more in addition, and its fields of use and influence is correspondingly broader.

Had Howell been an artist-naturalist as well as geologist, his work must have developed along different channels, for the naturalist mind will not be satisfied with the diagram as a representation of the expressive surface of the earth. That Howell tried to satisfy his clients, who, as Dr. Gilbert writes, "were numerous among the investigators and teachers of geology and geography," is without doubt, and had this influence been that of men well versed in art or its applications as in architecture, landscape gardening, sculpture or painting, it must have tended to direct his work toward a naturalistic conception.

The men who have done most to develop the subject of representation in land relief have invariably had artistic instincts and training as well as a technical knowledge of earth form. Professor Albert Heim, the most eminent geologist of Switzerland, an artist by disposition, may be regarded as the world's pioneer in the rational interpretation of relief work on the lands and the principles of naturalistic earth representation. Schrader, of Paris, geographer and artist, has contributed to the progress; Imfeldt, engineer and artist, has produced remarkable work among the mountains of Europe. Had Professor W. H. Holmes brought his own rare geologic and artistic ability to bear on this subject there is little doubt that the United States would today stand high in the work that has been produced in the most accurate, complete, and expressive means for representing the face of our earth, the naturalistic land model.

G. C. CURTIS

BOSTON,
June 1, 1911

A FUND FOR PUBLIC SCHOOL BETTERMENT IN PITTSBURGH

Two years ago a generous friend of education placed in the hands of a small commission a fund of $250,000, the income from which was to be used for public school betterment in the city of Pittsburgh of which Dr. John A. Brashear is chairman. The commission sought and obtained the advice of many of the foremost educators as to best means of helping the grade schools in the way of increased efficiency, with particular reference to the betterment of the social, physical and moral improvement of the students, as also their preparation for life's work.

As a result of many conferences, it was decided to send 70 selected teachers to various summer schools in this country with instructions to take only those studies which tended to greater efficiency in the lines above noted, and at the same time to conserve their own health by combining rest and recreation with their summer courses. As a result very interesting and valuable reports were brought back by at least 85 per cent. of those who were sent away for study, and the school year just passed has demonstrated the fact that the teachers came back with increased enthusiasm and a desire to share the benefits derived from their studies with their fellow teachers.

With such satisfactory results from last year's labors, the commission decided upon the same general plan for this year—and after a most careful study of the nearly 500 applicants for scholarships—from the 1,700 teachers of the city—one hundred and thirty-five have been selected and will be sent to the following institutions:

Columbia University	21
Harvard University	21
Cornell University	11
University of Pennsylvania	4
University of Chicago	6
Chautauqua	13
Pennsylvania State College	2
University of New York	3
Grove City College, Pa.	5
University of Pittsburgh	
Long term	8
Short term	35
Chicago School of Applied Arts	1
New York School of Applied Arts	1
New York School of Philanthropy	1
New York Kindergarten College	1

With a surplus of the fund left over from last year the commission has organized a vocational bureau to look after the interests of the boys and girls who must leave the grade schools to earn a livelihood which promises so well that we hope to show its great value to the new school commission, which will take charge of our public schools on the first of January, 1912, and induce the commission to make it an integral part of the public school system.

Associated with this, though not directly connected with it, a hospital school for the study of defective children has been doing splendid work.

HONORARY MEMBERS OF THE AMERICAN PHYSICAL EDUCATION ASSOCIATION

THE American Physical Education Association at its recent meeting passed the following minute:

The American Physical Education Association wishes to place on its records an expression of its regret and sorrow at the loss, within the past year, of three of its honorary members.

These three men have made large contributions to the science of human welfare and have helped greatly in establishing certain fundamental principles on which physical education rests.

One of these men was our neighbor and friend, Edward Hitchcock, of Amherst. He was one of the founders of this association, a man of heartiness, sympathy and common sense; eager and untiring in his work for young men, catholic and optimistic in his love for humanity; unconscious of the evils of the world, for he was always looking for the good; a brother to every soul struggling upward. He worked for his college, for his state and for the nation. While he always worked from a scientific basis he was a moral force rather than a scientist; he was a great teacher rather than a discoverer.

The second was the man who inspired more scientific study of man in the last thirty years, perhaps, than any other of the English-speaking race, Sir Francis Galton, of London. Of a family famous throughout the world for intellectual achievement he added much to its fame. He was endowed with a high ability in mathematics and his method of percentile study of vital statistics opened a new field in anthropometry, while his mechanical genius brought into working form many instruments for testing size, strength and working power. He saw the work to be done and he had a marvelous power to see the best manner of doing it. He has pointed out the road to many a man who could not see clearly, for his vision knew no bounds and physical capacity was his only limit.

The third member, whose memory will go with us as a cheering influence, was Angelo Mosso, of Turin. As a physiologist he first turned scientific attention to the interrelations of mental and physical activities. His methods of study and research were original and he developed many ingenious mechanical devices for recording changes in the human body that were due to mental and physical action. His special contribution to America was on "Psychic Processes and Muscular Exercise" at the request of President Hall, of Clark University in 1899.

As these masters of thought and leaders in the search for truth pass from our membership it should quicken our sense of responsibility in the work of the future for our department and make us more zealous for all good work for humanity, the study of which is the noblest task of the mind.

J. H. McCurdy
J. W. Seaver
P. C. Philips

SCIENTIFIC NOTES AND NEWS

The building named for Dr. Edward Williams Morley at the Western Reserve University and devoted to the departments of chemistry and geology, occupied this year for the first time, was opened for formal public inspection during commencement week. The building contains a tablet, bearing testimony to Dr. Morley's work in science, and to his thirty-seven years of active service in Western Reserve University.

Dr. Charles L. Parsons, professor of chemistry at the New Hampshire College, has received the doctorate of science from the University of Maine.

Dr. William G. Davis, professor of orthopædic surgery in the University of Pennsylvania, has been given the doctorate of laws by Lafayette College, and Dr. P. H. Musser, professor of medicine in the same institution, the degree of doctor of laws by Franklin and Marshall College.

Dr. Samuel Sheldon, professor of physics and electrical engineering at the Brooklyn Polytechnic Institute, has received the degree of doctor of science from Middlebury College, from which he graduated in 1883.

Professor W. M. Davis, first president of the Harvard Travelers Club, has been awarded the club medal for his work as a traveler and geographer.

The German emperor has bestowed on Professor Ehrlich the title of excellency and has appointed him an active privy councillor. The German physicians who have hitherto received this appointment are Koch, von Behring, von Bergmann and von Leyden.

Dr. Emil Godlewski, professor of agricultural chemistry at Cracow, has been elected a corresponding member of the Paris Academy of Sciences.

PROFESSOR WALDEYER, the eminent anatomist of the University of Berlin, will celebrate the fiftieth anniversary of his doctorate on July 22.

DR. ERICH MARTINI, who has been studying the bubonic plague in the far east for several years, has been visiting in New York City, before returning to Germany.

DR. GEORGE E. HALE, director of the Mount Wilson Observatory, has returned to this country after a prolonged visit to Europe.

DR. H. C. COWLES, of the department of botany at the University of Chicago, sailed in June to spend six months in Europe. He is to attend the British Association, in connection with which there is to be an excursion of plant geographers in England. He will spend some time in France and Switzerland, and will attend the Tenth International Geographical Congress in Rome, October 15–22.

DR. CHARLES J. CHAMBERLAIN, of the department of botany at the University of Chicago, will leave Vancouver in September for a visit to New Zealand, Australia and South Africa, returning April 1, 1912. His principal object is to study Cycads in the field and to collect material, not only of Cycads, but of other Gymnosperms as well, for detailed study, and also to pay special attention to Pteridophytes. The expedition is being made under a grant by the university.

DR. W. W. STOCKBERGER, of the Bureau of Plant Industry, Washington, D. C., sailed, on July 8, for Hamburg, and will spend three months in special agricultural investigations in Germany, Austria, France, Belgium and England. He will also attend the International Conference on Genetics which will be held in Paris in September.

DR. ARTHUR ORLO NORTON, assistant professor of education at Harvard, is writing a history of the German universities, and he is now in Italy to consult the libraries, especially in Florence and Padua.

THERE will be held a Congress of Monists at Hamburg from September 8 to 11, with Professor Ernst Haeckel as honorary president, and Professor Wilhelm Ostwald as presiding officer.

Nature reports that at the meeting of the Association Internationale de l'Institut Marey held on June 6, the resignation of Professor Kronecker as president was received. The members of the association elected Professor Charles Richet as president, and Dr. Augustus D. Waller as vice-president. The Institut Marey is under the patronage of the Associated Academies. It is situated in the Parc des Princes, Boulogne-sur-Seine, Paris, and contains laboratories, library and living rooms for the accommodation of workers. The acting director is Dr. Lucien Bull.

A MONUMENT to John Stuart Mill is being erected at Avignon, where he resided during the last years of his life, and where he died in 1873.

DR. G. JOHNSTON STONEY, F.R.S., born in Ireland in 1826, eminent for his contributions to astrophysics, died on July 5, at his home in London.

DR. HARRIS EASTMAN SAWYER, A.B., A.M., Ph.D. (Harvard), assistant chemist in the Bureau of Chemistry until he removed to New Hampshire on account of pulmonary tuberculosis, the author of contributions to the chemistry of sugar and alcohol, died on July 5, aged forty-three years.

MRS. ESTHER HERRMAN, a patron of the American Association for the Advancement of Science and for many years a regular attendant at its meetings, a liberal benefactor of the scientific societies of New York City, died on July 4, in her eighty-ninth year.

ACCORDING to the daily papers the earthquake of July 1 did considerable damage at Lick Observatory, on Mount Hamilton. The 36-inch telescope was moved three-quarters of an inch out of place on its concrete pier, but was restored without trouble. The case of the Riefler clock was wrecked and minor damage was done to the working parts. The chimneys of the observatory buildings were injured and a brick structure which houses a number of astronomers was cracked so as to

be unsafe for occupancy. The shock was the most severe that has been felt at the observatory.

A TELEGRAM received at the Harvard College Observatory from Professor R. G. Aitken, of the Lick Observatory, states that a comet discovered by Kiess was observed by Kiess July 6.9794 Greenwich mean time in

R.A. $4^h\ 51^m\ 51^s.8$
Dec. $+\ 35°\ 15'\ 02''$

The comet can be seen with an opera glass. It is moving southwest, and has a visible tail.

THE United States Weather Bureau is forming in its library, at Washington, a collection of meteorological photographs, and will welcome additions thereto from all parts of the world. The following classes of pictures are among those desired: (1) views of meteorological offices, observatories and stations; (2) pictures of meteorological apparatus; (3) portraits of meteorologists, views of their homes and birthplaces; (4) views showing the effects of storms, inundations, freezes, heavy snowfall, etc.; (5) cloud photographs; (6) photographs of optical phenomena (rainbows, halos, Brocken specter, mirage, etc.); (7) photographs of lightning and its effects; (8) photographs of meteorologically interesting pictures in old books, or of early prints and paintings (*e. g.*, contemporary pictures of the damage wrought by the great storm of 1703, in England). Persons who are willing to present such pictures to the Weather Bureau, or who will furnish them in exchange for Weather Bureau publications, are requested to address: Chief U. S. Weather Bureau (Library), Washington, D. C. It will add much to the value of these pictures if the sender will kindly note on the back of each as much pertinent information as practicable. On pictures of classes 4–7, inclusive, should be stated at least the date, hour and place at which each picture was taken, and the direction toward which the camera was pointed.

THE interest manifested in recent developments in the study of heredity and evolution and the application of this new knowledge to plant, animal and human life has led to the presentation of a series of public lectures on these topics at the University of Chicago this summer. The lectures are open not only to students, but also to the general public. Three lectures were given in June. The first was a survey of general advances in science by Professor John M. Coulter, of the University of Chicago; another on "Variation, the Basic Factor in Evolution," by Associate Professor William L. Tower, of the University, and a third on "Variation, Heredity and their Relation in the Production and Perfection of New Races," by Dr. Tower. During July, the following lectures are being given in Kent theater:

July 5—"Mendel's Law of Heredity," William Ernest Castle, Ph.D., professor of zoology, Bussey Institution, Harvard University.

July 6—"Heredity, Selection and Sex," Professor Castle.

July 12—"Inheritance and Evolution in Higher Plants," Edward Murray East, Ph.D., assistant professor of experimental plant morphology, Harvard University.

July 19—"The Cytological Evidences of Germ Cell Constitution and Modification," Professor Coulter.

July 20—"Experimental Evidences of the Physical Constitution and Changes in Germ Cells," Associate Professor Tower.

July 26—"Inheritance of Physical and Mental Traits in Man, and their Application to Eugenics," Charles Benedict Davenport, Ph.D., director of the Station for Experimental Evolution, Carnegie Institution.

July 27—"The Eugenic Significance of the Geography of Man," The Eugenics Movement, Professor Davenport.

UNIVERSITY AND EDUCATIONAL NEWS

THE Nevada State University has received $250,000 from Mr. Clarence Mackay, of New York City, and several of his friends, for the construction of a library and administration building.

MR. ROBERT CHRISTISON has offered to contribute a further £1,000 (having already given £1,000) for the foundation of a chair for tropical and sub-tropical agriculture in the University of Brisbane.

THE salaries of professors in Oberlin College have been increased $200 each, and the salaries of associate professors $300 each, these increases to go into effect at the beginning of the next college year.

ALL of the qualified men in this year's graduating class in the College of Agriculture of the University of Wisconsin have secured positions and the requests for teachers are still coming in. The demand is especially strong from agricultural high schools both in Wisconsin and other states. Many of the requests are for men who have been brought up on farms, have had some teaching experience and also have had a thorough course in agriculture. The demand for such instructors in agriculture for high schools is very much greater than the supply. Even as early as four weeks ago most of the seniors had accepted positions as farm managers, as research assistants, or as teachers of agriculture in colleges and secondary schools. The average salary of the men who will teach next year in agricultural schools is $1,253.

PROFESSOR G. A. BLISS, of the University of Chicago, and Professor Max Mason, of the University of Wisconsin, have been appointed lecturers in mathematics at Harvard University, the former for the first, and the latter for the second half of the academic year.

DR. STEWART PATON '86, has been appointed lecturer in biology at Princeton University.

DR. GEORGE S. MOLER, has been promoted to a full professorship of physics at Cornell University.

R. C. MULLENIX, Ph.D. (Harvard), professor of biology in Yankton College, South Dakota, has been elected to a similar position in Lawrence College, at Appleton, Wis.

THE following instructors have been appointed at Princeton University: in the department of physics, C. J. Davisson and P. Rosenberg; in the department of electrical engineering, George Olshaussen, Ph.D.; in the department of biology, E. Newton Harvey, instructor in physiology; in the department of civil engineering, P. R. Bickford '11 and A. C. Cornish '11, instructors in civil engineering; J. H. Drummond '11, instructor in geodesy.

IN the Harvard Medical School instructors have been appointed as follows: Dr. Marshal Fabyan, in comparative pathology; Dr. F. P. Johnson, in histology and embryology; Dr. L. B. Nice, in physiology, and Dr. C. G. Page, in bacteriology.

DISCUSSION AND CORRESPONDENCE

CONCERNING THE "NEMATOCYSTS OF MICROSTOMA"

PROFESSOR KEPNER in a preliminary communication entitled "Nematocysts of Microstoma"[1] brings forward additional evidence showing that nettle capsules capable of subsequent discharge may be transferred from cœlenterates to flatworms much as they are from hydroids and actinians to eolids. The mechanism of this interesting and suggestive process is described in some detail, but it is hoped that this will be added to and clarified when certain proposed experiments have been carried out. Quite apart from its subject-matter, however, Professor Kepner's paper has an interest especially in the light of Dr. McDermott's recent "Plea for the Use of References and Accuracy Therein."[2]

Thus on page 271, almost seven lines are quoted and attributed to Boulenger, pp. 127–8. Not only are there no such pages in Boulenger's article,[3] but the words are taken from my own paper.[4]

In the next paragraph Professor Kepner states that the cuidophages of æolids deliver their nematocysts to the cnidocyst, whereas the endodermal cells of *Microstoma* deliver their nematocysts to the mesoderm. Unfortunately for the analogy, both Grosvenor[5] and I[6] have shown that the cnidophages after en-

[1] *Biological Bulletin*, Vol. XX., No. 5.

[2] SCIENCE, Vol. XXXIII., No. 857.

[3] *Quarterly Journal of Microscopical Science*, Vol. 55, No. 220.

[4] *Journal of Experimental Zoology*, Vol. 9.

[5] *Proc. Royal Soc.*, Vol. 72. This reference, correctly given here and in my earlier paper (1909), is incorrectly given as Vol. 22 in my second article (1910) and in Kepner's paper as well.

[6] *Ibid.*

gulfing a certain number of nettles, metamorphose directly into cnidocysts.

On page 275 Professor Kepner quotes Grosvenor through me, and adds "likewise no one can have witnessed the discharge of nematocysts of *Microstoma* when stimulated by pressure or acetic acid without looking upon them as organs of defense." Yet both Cuênot[1] and I proved that the defensive value of the nettles is slight if not negligible, whereas in 1909[2] I showed that under certain conditions (pressure, acetic acid) the discharge of nettles, even when enclosed in mother tissues or in eolids, may be no more the outcome of physiological stimulation than the explosion of a pistol is the result of a "stimulated" trigger.

In conclusion, Professor Kepner raises the question whether eolids have "acquired their method of dealing with nematocysts of cœlenterates through flatworm ancestry." To any one acquainted with the relationships, not only of molluscs, but of the particular ones under discussion, this question is a bit surprising, for not only is the supposed flatworm ancestry of the mollusca exceedingly problematical, but gastropods are not primitive molluscs, nor are nudibranchs primitive gastropods. One would certainly expect indications of the "nematocyst-habit" in primitive forms if there were any reasonableness in the phylogenetic point of view as applied to this problem.

Otto C. Glaser
Marine Biological Laboratory,
Woods Hole, Mass.,
June 22, 1911

Double Mutants in Silkworms

To the Editor of Science: Referring to Professor Kellogg's interesting report on "Double Mutants in Silkworms," in Science of May 19, 1911, I would call attention to the fact that in his original publication the puzzling data regarding the inheritance of the white cocoon character is made clear by the assumption of two kinds of white, one dominant to color, the other recessive to color. In some of his original data certain individuals were evidently heterozygote for these two kinds of color. The recognition of both a dominant and a recessive white will also explain some of the puzzling phenomena reported in the more recent data.

W. J. Spillman

[1] *Arch. de Zool. Exp.*, 4e S., T. 6.
[2] *Journal of Experimental Zoology*, Vol. IV.

Exploded Theories and Theological Prejudice

These are expressions used in Professor White's review of the new edition of "The Ice Age in North America." The exploded theories mentioned are "the Calaveras skull," "the Lansing man" and "the Nampa figurine." The error concerning the Calaveras skull figured by Whitney is freely granted in the book. But that there was a skull found as described, and other remains of man, in the auriferous gravels is still supported by a sufficient amount of convincing evidence to command attention.

As to the Nampa figurine, I am not aware that any one has brought anything but theoretical considerations to bear against the evidence originally collected by Charles Francis Adams and his associates immediately after its purported discovery; while the theoretical considerations are based, as I have shown, upon misunderstanding of the geological conditions. The cataclysm connected with the bursting of the upper barriers of Lake Bonneville, and the pouring of its waters into the Snake River valley must be reckoned with before the conditions reported at Nampa are set down as incredible.

The facts relating to the Lansing man are, I think, sufficiently set forth in the book to, at least, merit attention. If we are to accept every attempt to explode a theory as successful we shall soon come to a standstill in our discussions.

As to theological prepossessions, I only remark that it is as easy to impute *anti-theological* prepossessions, as to suspect theological bias. In any event the facts themselves should not be overlooked. Let us have fair play.

G. Frederick Wright
Oberlin, O.,
June 17, 1911

QUOTATIONS

THE PRESIDENT AND THE FOOD AND DRUGS ACT

WE have, for the past three weeks, called attention to the failure of the federal Food and Drugs Act, under the interpretation recently given it by the Supreme Court, to protect the public against loss, both in health and pocket, from lying claims regarding the curative effects of nostrums. As soon as the new interpretation became public, some of the more progressive members of Congress began to plan for getting an amendment to the pure food law that would specifically prohibit untruthful claims for therapeutic effects of drugs. President Taft, on June 21, took official cognizance of the blow that the Supreme Court decision had dealt the Food and Drugs Act by sending a special message to congress urging the very amendments that are needed to restore that law to its previous efficiency. Said the President:

> An evil which menaces the general health of the people strikes at the life of the nation. In my opinion . . . the sale of drugs under knowingly false claims as to their effect in disease constitutes an evil and warrants me in calling the matter to the attention of the Congress.
>
> Fraudulent misrepresentations of the curative value of nostrums not only operate to defraud purchasers, but are a distinct menace to the public health. There are none so credulous as sufferers from disease. The need is urgent for legislation which will prevent the raising of false hopes of speedy cures of serious ailments by misstatements of the fact as to worthless mixtures on which the sick will rely while their diseases progress unchecked.

To meet the objection that has been raised in some quarters that the curative effect of nostrums is a matter of opinion and not of fact and that the opinion will vary both as regards the so-called schools of medicine and also as to individuals of the same school, Mr. Taft says:

> No physician of standing in his profession, no matter to what school of medicine he may belong, entertains the slightest idea that any of these preparations will work the wonders promised on the labels.

And further:

> Of course, as pointed out by the Supreme Court, any attempt to legislate against mere expressions of opinion would be abortive; nevertheless, if knowingly false misstatements of fact as to the effect of the preparations be provided against, the greater part of the evil will be subject to control.

That the amendment suggested by the President will be fought by the "patent medicine" interests is to be expected. The Proprietary Association, as recently as June 17, sent out a letter purporting to give "the legal aspect of the Johnson case." The gist of the letter is contained in the following sentence that appears in it:

> As there is no science in therapeutics, the practise of medicine being based on opinion and not on definite scientific facts—any statement concerning the curative properties of any drug, chemical or medicine, is largely a "matter of opinion." . . .

In the opinion of the Proprietary Association—in other words, in the opinion of "patent medicine" makers—"the effect of the decision of the Supreme Court does not change or weaken the Food and Drugs Act in any particular."

President Taft, as evidenced by his special message, disagrees with the "patent medicine" men, for in his message he says:

> I fear that if no remedial legislation be granted at this session the good which has already been accomplished in regard to these nostrums will be undone, and the people of the country will be deprived of a powerful safeguard against dangerous fraud.

We believe that the restrictions the President would have placed on the nostrum business are more likely to meet with public approval than the "wide-open" policy advocated by the makers of "patent medicines." Amend the act!—*Journal of the American Medical Association.*

SCIENTIFIC JOURNALS AND ARTICLES

THE *Journal of Experimental Zoology* for July contains two articles: "Assortative Mating, Variability and Inheritance of Size, in the Conjugation of Paramecium," by H. S.

Jennings, and "The Reproduction of Paramæcium Aurelia in a 'Constant' Culture Medium of Beef Extract," by Lorande L. Woodruff and George A. Baitsell.

The contents of the last issue of the *Philippine Journal of Science* in the section devoted to chemical and geological sciences and the industries contains articles as follows: "Philippine Firewood," by Alvin J. Cox; "Quinine Esters of Phenylarsinic Acid Derivatives," by K. J. Oechslin; "The Mechanical Analysis of Soil," by Wallace E. Pratt; "The Economic Possibilities of the Mangrove Swamps of the Philippines," by Robert R. Williams.

SCIENTIFIC BOOKS

Reptiles of the World. By Raymond Ditmars. New York, Sturgis & Walton Company. 1910. Pp. xi + 373; 89 plates, 1 colored.

Of the numerous popular books on natural history that have appeared recently, few probably meet a greater need than this comprehensive work on the reptiles of the world. It is thus fortunate that Mr. Ditmars has undertaken the task, for his long connection with the New York Zoological Park has given him familiarity with living examples of a large number of forms and a knowledge of the information desired by the class of people who will presumably find most use for the book.

The limits of one volume do not, of course, permit a full treatment of the subject, but, as a rule, the author has used good judgment in the selection of material. All of the large groups are defined, down to and including the families, and the more important genera and species are described. The less important families, *i. e.*, those of less general interest, are given but a brief description, the less important genera and species are omitted, and genera that contain a large number of closely similar species, *e. g.*, the Anoles and Sceloperi, are given a rather full description supplemented by a short account of a few of the better known forms. The book is thus not burdened with details.

The descriptions are brief, couched in non-technical terms, and admirably supplemented by excellent illustrations from photographs, mostly of living animals. It is refreshing to find the habits so fully discussed. They are given nearly as much space as the descriptions (in some cases more), and even when it has been necessary to treat a group very briefly the general habits are often given. The range is outlined in each case, and about as fully as one can expect in such a work.

It is not easy to criticize the book when one keeps in mind its aim "to give in a popular manner a general survey of the reptiles of the world." Thus, while the lack of detail in many places and the too brief and general descriptions will be regretted by scientists, they can not be condemned, for they are unavoidable defects in a book of this kind. However, the author makes the further statement that "while the manner aims to be popular . . . it is at the same time, the writer hopes, everywhere in accord with the latest results of the scientific study of the subject," and there will be differences of opinion on this point.

In the first place, it is to be regretted that a more recent nomenclature has not been used. It goes without saying that a book of this kind can not give space to nomenclatural disputes, and it may even be admitted that it may profitably retain names that have been replaced, if the new names have not as yet become well established in the literature. But it seems to the reviewer that nothing is to be gained by adhering to old names when the new ones have become reasonably well known (*e. g.*, *Lacertilia* for *Sauria*, *Ophidia* for *Serpentes*, *Eutænia* for *Thamnophis*), and particularly in a book that aims to present the subject, no matter how popularly, in its present stage.

Another criticism that may be made is that relatively too much space is given to the habits of captive specimens. The habits in captivity furnish only a general clue to the habits in nature, and, as a rule, the activities of a captive animal are only a small part of the normal activities. Thus one may deter-

mine by a study of specimens in captivity whether a lizard is herbivorous or insectivorous, but from such data it is not possible to determine the range of diet, and generally impossible to work out at all satisfactorily the habitat preferences, reproduction, etc. It may readily be seen that this is true by an examination of this book, for it is the food that captive specimens will take that is given in most of the accounts of feeding habits, and habitat preference and reproduction come in for very brief treatment. The author might very profitably have included summaries of the published notes on the habits in nature. On the other hand, it is only just to acknowledge that the observations on the habits of specimens in captivity are of value, not only to those who wish to keep live material but also to scientists, for even general information is desirable in the case of many forms. Thus, on the basis of his observations on captive animals, Ditmars refutes the often repeated statement that the iguanas (subfamily Iguaninæ) and *Basiliscus* are strictly herbivorous (that they are also insectivorous in nature is a fact that may easily be demonstrated by an examination of the stomach contents of wild individuals), and the observations on the breeding habits of *Elaps fulvius* and *Lachesis mutus* are distinct contributions to our knowledge of the habits of these species.

In some respects the book-making is very good. There seem to be very few typographical errors. The upper figure on plate 3 is upside down, and in the table on p. 100 the genus *Coleonyx* is placed under the family Uroplatidæ by a printer's mistake. But these are very unimportant errors. The most unfortunate thing about the book from this standpoint is the absence of appropriate headings. The book is divided into four "parts," dealing with the turtles, crocodiles, lizards and snakes, respectively, but aside from this division there are no subdivisions of the subject matter, if we except the fact that there are center heads to the sections on the structure of lizards, the family Boidæ, and the new world Elapine snakes. The names of the families considered are usually given as side heads and the common names given to families when used as side heads and the common names of the genera and species when beginning a paragraph are placed in small capitals, but this is not sufficient to break up the text conveniently, and it is very difficult to find the descriptions of particular forms. The author states that "the scope of the book prevents it from being, as a previous book ['The Reptile Book'] by the same author was, primarily a volume for identification purposes," and it is probably for this reason that the excellent arrangement of the former work was not followed, but the value of the book could have been greatly increased by the use of at least a general system of headings, such, for example, as the one employed in Knowlton's "Birds of the World." Another fault in the arrangement is that the plates are not referred to in the text, and, as they are often far removed from the descriptions of the species, they can not be conveniently found.

One may, however, easily overlook the defects in the book for it is a valuable contribution to the subject. It is a good popular account, as the author intends it to be, and at the same time it will find its place on the shelves of the general zoologist and herpetologist, both for its very excellent illustrations and for the information on habits that it contains.

ALEXANDER G. RUTHVEN

Natural Vegetation as an Indicator of the Capabilities of Land for Crop Production in the Great Plains Area. By HOMER LEROY SHANTZ, Physiologist, Alkali and Drought Resistant Plant Breeding Investigations. Bulletin 201, Bureau of Plant Industry, U. S. Department of Agriculture. Washington. 1911. Pp. 100; 6 plates and 23 text figures.

This first endeavor to apply the exact methods of quantitative ecology to the problems of agriculture meets with conspicuous and gratifying success. The author is as skillful as thorough in his use of instrumental and

quadrat methods, and he is especially fortunate in his application of the principles of the development and structure of vegetation to a complex vegetational problem. The close and careful analysis of water factors and the intimate correlation of the natural vegetation with them will cause the present study to long remain a model for work in similar fields. The value of the natural crop as an index of agricultural possibilities is so clearly worked out that it must henceforth be taken fully into account in the survey of a new region. The present bulletin merits further praise for the happy way in which the newest ecological facts are combined with a knowledge of crop production in such a fashion as to yield results usable by both the scientists and the layman. It gives further evidence of the fact that the best scientific work is the most practical, and that practise can be permanent or successful only in so far as it is scientific.

In laying down principles for the use of the natural vegetation as an indicator, correlation with the physical or chemical nature of the soil, with rainfall or with temperature is held to be impossible for the region of the great plains. As the ecologist would expect, the water content of the soil furnishes the most reliable correlation, as the most important and controlling of all direct factors in an arid region. The author is probably correct also in insisting that the entire vegetation is a better indicator of conditions than any single species of it. Since the structure of a plant group varies considerably, however, it is not improbable that further study will reveal a few species which are the essence of the group, and hence the clue to it. Indeed, this is not far from the method used, as shown by the terms short-grass land, bunchgrass land, etc. The second step in the problem is to correlate the native vegetation, which should always be regarded as a crop grown by nature, with the culture vegetation, *i. e.*, the crop production. This correlation, of which the ecologist requires no proof, is practically possible only in so far as actual experiments in cropping have been made. In an arid region, all cropping is essentially experimental, and the necessary evidence, quantitative in a large degree, is at hand.

The first essential in correlating vegetation and conditions is a careful analysis of the former into its formations, associations and societies. Over a vast grass-land area, such as the great plains, this is peculiarly difficult, not only because of the disturbing effect of succession, but also on account of the ease of migration in all directions. Two typical grass-land formations are recognized, the prairie grass formation of the prairies proper, which extends westward into the shortgrass formation characteristic of the plains. The prairie grass formation in its plains portion falls into three groups, here called the bunchgrass, sandhills mixed and blowout associations. The shortgrass formation comprises three associations, grama-buffalo grass, wiregrass and *Gutierrezia-Artemisia*. These associations are not all stable groups of the final association, but some, notably the blowout and wiregrass associations, are initial or intermediate stages of a succession. Indeed, it is the skillful working out of the time sequence of the various associations which has made possible the correlations suggested.

The typical short-grass association is made up chiefly of two species, grama grass (*Bouteloua oligostachya*) and buffalo grass (*Buchloe dactyloides*). It is characteristic of loam or clay soils, the so-called "hard lands," upon which the author has worked out in convincing fashion the essential water relations. A thorough study of rainfall, run-off and penetration, rate of water loss, non-available water, and root systems brings out clearly the fact that it is the slight penetration of the rainfall on hard land which controls the root development, and consequently the establishment of the plant. The roots are from 12–18 inches deep, corresponding to a penetration of little more than 20 inches after the heaviest rains, and a consequent water content which repeatedly falls to the non-available during the summer. In accordance with this, the shortgrass association is an indicator of a small amount of available water, of

a short season for growth, and of a relatively high nutrient content. In connection with the heavier rainfall in June and July, the nutrient content of shortgrass land too often produces a deceptively luxuriant growth of crops, which are cut short by dwindling water content in late July and August.

The wiregrass association is dominated by *Aristida longiseta*. It is found chiefly on sandy loam, or at least on soils intermediate between the sandhills and the hard lands. The soil texture in wiregrass land permits greater penetration of rain, available water occurs deeper in the soil, and deep-rooted species become possible. The roots of wire-grass are from 2–3 feet long, while its usual associate, *Psoralea*, reaches a depth of 5 feet. There is nothing, however, to exclude the short-rooted grasses, and two species of grama often occur in this association. The wiregrass association indicates more favorable conditions for crop production than any other group. The soil is sufficiently compact to prevent blowing, and is well-supplied with nutrients. Water penetrates readily to a fair depth, and water loss is lessened by the air content of the sandy surface.

The soil of bunch-grass land is sand, and it allows rain to penetrate to a greater depth than either the hard land or the sandy loam. It contains more available water than these soils, but is relatively poorer in nutrients. Owing to its loose structure, it blows readily, and methods of cultivation must take account of this fact. The runoff from the sandhills is negligible, and the water loss from the soil surface slow, owing to the formation of a mulch of dry sand. The typical species of the association, bunch-grass (*Andropogon scoparius*), develops roots to a depth of 4–6 feet, as is the case also with its most frequent associates. The density of bunch-grass seems to be in direct relation to the water supply, and consequently a fairly close cover indicates a higher water content and better agricultural conditions. When the bunches are scattered, the short-grass finds an opportunity to establish itself in the spaces, utilizing the water content of the first soil foot.

The final vegetation type of the region is the shortgrass association, which may be reached through various successions. Of the two common primary successions, one begins with lichens on disintegrated rocks, passes into the *Gutierrezia-Artemisia* association, and as the soil becomes finer, terminates in the shortgrass association. The pioneers in a blowout initiate a longer succession. As a consequence of rendering the sand more stable, they yield sooner or later to a mixed association of sandhill plants, and finally to the bunchgrass association proper. The effect of fires or grazing is to change the latter to the shortgrass association, often through an intermediate wire-grass stage. When an association is destroyed by breaking the soil, the first vegetation will consist of weeds, but this will soon be replaced by the association which ordinarily precedes the one destroyed. For example, when short-grass is broken, *Gutierrezia-Artemisia* or wire-grass will take possession, to yield again to short-grass in the course of two or three decades, bunch-grass or other sandhill vegetation will temporarily replace wire-grass, etc. The cause of this is readily found in the loosening of the soil, while the reaction which brings back the original stage is seen in the increasing stabilization of the soil.

From the standpoint of crop production, the largest yields are obtained during favorable seasons from the shortgrass land, but failures are also most frequent on it. Bunch-grass land produces the smallest yield in good years, but on the other hand crop failures are rare. Because of its intermediate position, wiregrass land is usually the most valuable of all, since its productivity is not far below that of shortgrass land in good years, and it has much of the advantage of bunchgrass land in dry years.

FREDERIC E. CLEMENTS
THE UNIVERSITY OF MINNESOTA

Blumen und Insekten, ihre Anpassungen aneinander und ihre gegenseitige Abhängigkeit. Von Professor Dr. O. VON KIRCHNER.

Leipzig u. Berlin, B. G. Teubner. Pp. iv + 436, 159 figs.; 2 pls. 1911.

The large amount of literature which has been produced on the mutualistic relations of flowers and insects by Sprengel, Darwin, Delpino, Hildebrand, H. Müller, E. Loew, Chas. Robertson and numerous other investigators, and especially the recent publication of Knuth's exhaustive "Handbuch der Blütenbiologie" and its translation into English, would seem to render superfluous any further general presentations and to leave room, at least for some years to come, only for very special studies. An examination of von Kirchner's volume, however, shows it to be a very concise and useful compendium. The author presents the entomological aspect of the subject more fully than is usually attempted in similar works, one whole chapter being set aside for this purpose, after an introduction and two chapters on the meaning of pollination, the various ways in which it is brought about and the peculiarities of insect pollination, or entomogamy. Then follows a chapter on the general adaptations of flowers to insects. The bulk of the work is devoted to a concise and interesting discussion of the various types of entomogamy (Chapters VI. to XII.) according to H. Müller's classification of flowers into those which bear pollen only and those which produce nectar, and of the latter into various subgroups according to the accessibility of their nectaries or the peculiarities which make them specially attractive to Diptera, Hymenoptera or Lepidoptera. The ability of the author to present matters clearly and briefly is well shown in his account of the classical cases of the yucca moth and the caprification of the fig, while his balanced and temperate judgment finds expression in the three concluding chapters of the work, which deal with floral statistics, the causes of the mutualistic adaptations of flowers and insects and the various hypotheses which have been advanced to account for the phylogenetic origin and development of floral structures. That rare thing in so many recent German books, a good index, is added. The text is well-illustrated with a number of large clear figures, mostly from drawings by the author. A few of these figures, however, are open to criticism, for example, Fig. 16. which represents the abdomen of the bee *Osmia spinulosa,* is up-side-down, and Fig. 10, representing the olfactory organs of insects, is woefully archaic and should be replaced in a future edition by an up-to-date illustration. It is to be hoped that von Kirchner's work will be translated into English so that it may become more useful to students in the United States and inspire further observations on the mutualistic relationships of our native flora and insect fauna.

W. M. Wheeler

SPECIAL ARTICLES

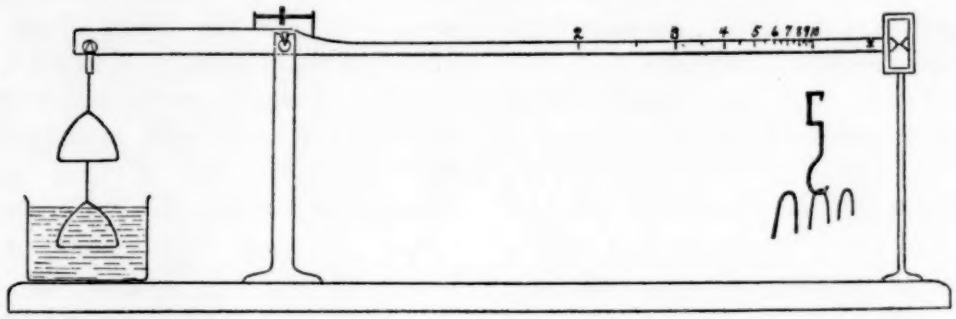
A NEW SPECIFIC GRAVITY BALANCE

The Specific Gravity of Minerals.—As the specific gravity is one of the most constant properties of minerals, its determination for pure massive specimens is one of the best means of identification. The accurate determination of specific gravity is a slow and painstaking process. A simple and rapid method which will give approximate results suffices for many purposes. The Jolly spring balance and a beam balance,[1] which depend upon the well-known principle of hydrostatics that a substance immersed in water loses in weight an amount equal to the weight of the water displaced, are fairly satisfactory. Two or three readings are made from which the value of the specific gravity is obtained by calculation. Though the calculation is simple enough it takes time and one is apt to make mistakes. The writer has designed a modification of the beam balance which it is believed will be found more convenient than these other forms, as the specific gravity is read off directly, the calculation being made once for all and recorded as graduations on the beam.

The New Balance.—The accompanying figure, which is one sixth actual size, shows the

[1] Brush-Penfield, "Determinative Mineralogy," sixteenth edition, p. 235. Geikie, "Structural and Field Geology," second edition, p. 428.

essential features of the balance. A brass support rests upon a wooden base and carries the knife-edge of a beam made of one eighth inch brass about twenty inches long. The short arm of the beam bears a knife-edge from which is suspended two pans about one and a half or two inches in diameter. When in use the lower pan is in water and the upper



one in air. The end of the long arm of the beam rests within a guard supported by an upright which limits the motion of the beam. The long arm is graduated and carries a knife-edge counterpoise with hook at the lower end on which may be hung wire loops. In the figure the counterpoise and the wire loops are about one third actual size. The three knife edges are all in one line. Just above the fulcrum is a device for accurate adjustment.

The Graduation of the Balance.—The long arm of the beam is graduated so that the specific gravity may be read off directly. The formula for specific gravity by hydrostatic weighing is

$$G = A/(A - W);$$

where G is the specific gravity, A the weight in air and W the weight in water. Now if we use the same counterpoise with weight p, say, for both weighings, $A = px$ and $W = py$, where x and y are distances of the counterpoise from the fulcrum when weighed in air and in water, respectively. The equation then is

$$G = px/(px - py),$$

from which p may be eliminated, leaving

$$G = x/(x - y).$$

Hence the actual weights need not be known. When the weighings are in air, if the counterpoise is always placed at the same point (in the notch near the end of the beam) x becomes constant. Then the position of the counterpoise when weighings are made in water may be marked on the beam for different values of G. The equation given above may also be written

$$x - y = x/G.$$

The distance of the counterpoise from the notch in the beam or $x - y$ is equal to the length of the beam divided by the specific gravity. Thus if x, length of the notch from the fulcrum, is 15 inches (as in the present balance), when G is 2, $x - y = 7.5$ (15/2). So a point 7.5 inches from the notch is marked 2. When G is 3, $x - y = 5$ (15/3). A point 5 inches from the notch is marked 3 and so on. The graduation is in units from 2 to 10, in tenths from 2 to 4, in fifths from 4 to 6, and in halves from 6 to 10.

Adjustment.—The short arm, including the pans, is a little heavier than the long arm. But when the lower pan is immersed in water the beam should about balance, as a substance loses weight when immersed in water. Perfect adjustment is made by the device placed above the fulcrum. But this can be dispensed with, for the position of the beam depends upon the depth of water in the vessel. When no water is in the vessel the short arm is heavier than the long arm. So water is poured into the vessel until the beam is balanced.

Use of the Balance.—When in adjustment the balance will look like the figure, the lower pan being in water and the long arm of the beam free. (1) Place mineral in the upper pan. Place counterpoise at the notch near the end of the long arm and counterbalance

by adding wire loops. (A series of loops of varying lengths is needed.) (2) Next transfer the mineral to the lower pan. It will lose weight, so the counterpoise is moved toward the fulcrum until balance is restored. The specific gravity is then indicated by the position of the counterpoise on the beam.

Accuracy.—Tried with such minerals as quartz and calcite, this balance is accurate to about two units in the second decimal place for two or three grams of material.

A Portable Balance.—A convenient balance for rough work in the field may be made of a thin strip of wood, such as a foot ruler, driving a nail through for a fulcrum. To the short arm is attached a thin cord with rubber elastic for holding the mineral. The long arm is graduated so that the specific gravity may be read off directly as previously described.

The balance upon which the above description is based was constructed by Mr. F. A. Stevens, mechanician at Stanford University.

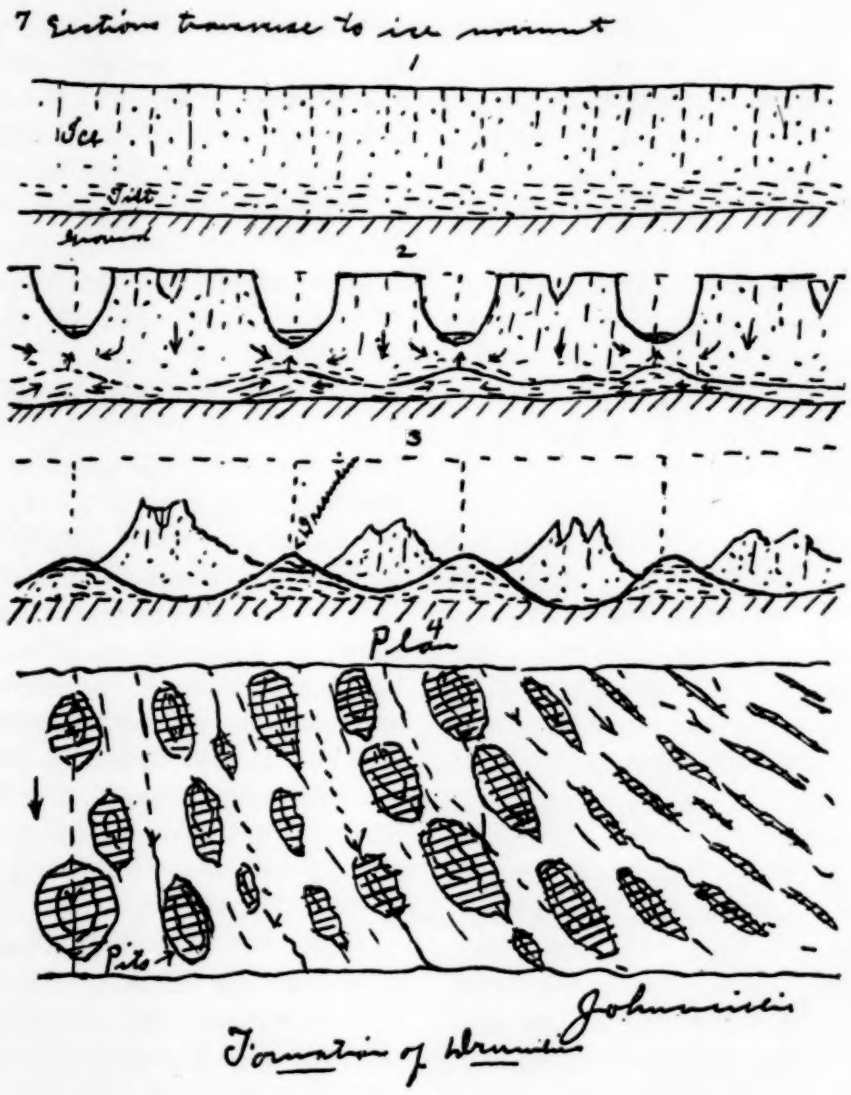
Austin F. Rogers
Mineralogy Laboratory,
Stanford University, Cal.,
April, 1911

What caused the drumlins?

To the Editor of Science: The following is a concise outline of a theory offered as an explanation of the process of formation of the peculiar smooth-contoured hills and ridges called *drumlins* and their allied topographic forms that occur in certain localities within the areas of the earth's surface formerly occupied by the ice sheet, notably in central New York, in southern Wisconsin, in portions of New England and of Canada, and in Ireland. These features of the surface have been the subject of much study and speculation and of a variety of theories, but so far as I can ascertain from available literature on the subject, the explanation here given has not heretofore been proposed.

During the period of dissolution of the ice covering certain glaciated areas, commonly called the period of "retreat" of the ice sheet, melting took place in the upper surface as well as on the front wall or slope. Owing to the strains in the ice mass produced by the forces that caused and attended the general advance of the sheet its internal structure had become such as to modify the process of melting from the upper surface. Before melting began there had been formed in the ice a system of vertical and parallel cleavage planes and fissures and the general direction of these conformed to the direction of the ice movement, owing to the forces above referred to. The assumed difference between a general ice sheet on a nearly horizontal surface and an individual glacier with a steeper descent in respect to cleavage is here to be noted. Changes of temperature with the changes of season may have had something to do with this structure. During the melting process the upper part of the ice sheet became deeply pitted or honey-combed on a somewhat gigantic scale because of the fissures and cleavage planes, and the pits were more or less elongated horizontally in the direction of these fissures and planes. As the melting proceeded on the internal surfaces of the pits, enlarging them, of course, the earthy matter in the upper parts of the ice, including stones, boulders, sand and gravel, dropped to the bottom of the pits and this material was thus subjected to a certain amount of water action and washing while the water drained away. With the enlargement and deepening of the pits and the removal of water the areas of ground ice and land surface beneath the pits were relieved of a large portion of the vertical pressure which the full thickness of the ice sheet had produced, while between the pits this pressure remained nearly the same as before melting started. The consequence was that a slow movement or flow of bottom ice towards the pits and an upheaval in the bottoms of the latter took place, and this lateral and concentering and upward ice flow at the bottom would, of course, carry with it the "till" material which was located principally in the lower portions of the glacial sheet, and a certain amount of the underlying material as well. There may have been periods during which the general melting was checked, due to seasonal changes of temperature or other

causes, while the above concentering ice flow at the bottom continued. Meanwhile the general advance of the remains of the ice sheet had not entirely ceased and this movement exerted a modifying influence in producing the surface forms that eventually resulted. Finally, as the ice faded away and the water drained off the englacial matter was quietly laid down in the smoothly rounded hills and ridges with intervening plane or hollowed in and under the ice by the movements described, and what may be termed its precipitation as the ice and water disappeared by melting and slow drainage respectively, were the principal formative causes. If the drumlin area was subsequently again covered by ice, this was probably of moderate thickness and was formed largely in place by accumulation of local snow fall in excess of the rate of melting, with a limited forward movement of



surfaces that constitute the hitherto mysterious drumlin topography.

The forms of these surface features are doubtless attributable in some degree and in certain localities to the direct action of overmoving ice, either during formation or subsequently, but it seems probable that the gathering up of the drumlin material while the sheet; the effect on the surface being like laying down a heavy blanket over it and then dragging the blanket forward, rather than like pushing over the area a thick ice sheet with a definite front edge.

The original forms of the drumlins appear to have been remarkably preserved since the ice period by the conditions of soil and climate

favorable to a protecting covering of vegetation, and by a texture and composition of the material that are adapted to the absorption of water falling on the surface and to effective subsurface drainage, so that there has been little change by surface erosion or washing.

The forms of surface produced in any particular locality would, of course, be effected by a variety of conditions, such as the original topography and surface material of the drumlin area, the thickness of the ice sheet, the rate of its movement, and the nature, amount and location in the mass of the ice of the englacial material; the rate of melting and its degree of regularity and continuity, and the direction of the general movement of the ice sheet and the direction of the prevailing winds, since these would affect the action of the sun and atmosphere on the shape of the pitting in the ice. The rate at which the water was drained away would be a factor, too, as would also be the general climatic conditions during the melting period.

Besides offering a "workable hypothesis" as to the causes of the drumlin forms and their orientation, the above theory appears to explain many observed details that it has been heretofore difficult to account for satisfactorily. Among these may be mentioned the occurrence of the drumlins generally on approximately flat and level areas, the approximation roughly to uniformity in height in any given locality or group, and the nearer approximation to uniformity of spacing transversely to the direction of ice movement than parallel thereto where the drumlins are closely clustered; the internal composition of the drumlins, which is usually a compact till material with occasionally layers or strata of sand, gravel and boulders, these layers being usually near the top and conforming more or less closely to the curvature of the outer surface; the evidences of formation by lateral collection of local and recently deposited material; indications of lateral compression of the mass of the drumlin; the form of cross section sometimes seen which has quite flat side surfaces inclined to be hollow instead of convex and with a tendency to a sharp central ridge or apex; greater steepness of slope on one side than on the other in the drumlins of certain groups; more abrupt slopes or greater bluntness on the ends turned towards the source of the ice flow than on the other ends; the characteristic hollows between the drumlins and the troughs and hollows at their bases that are found in certain drumlin areas; and finally, what has seemed to the writer more puzzling than any other feature, *the departures from type forms;* the irregularities and variations in the shape and in the orientation of the drumlins, and their frequent close association with morainic deposits of quite different character. The variations of form are from greatly elongated slender ridges of very low relief to high hills with nearly circular horizontal contours—the "Bunker Hill" type of the Massachusetts region—and to hills only approximating to drumlins called "drumloids," while there are a few cases of drumlins elongated transversely to the direction of ice movement. Some characteristic drumlins are curved horizontally in their length, some appear to be branched or multiple, and many considerable departures in orientation from the local direction of movement of the ice sheet are to be found. These apparently abnormal shapes and positions are attributable to local peculiarities of the original land surface, and to the variations in the internal structure of the ice and in the direction of the fissures and cleavage planes. No doubt there are other causes.

As to the absence of drumlins from areas apparently favorable for their formation under the above theory, it can only be said at present that for some reason the various contributing causes were not so balanced or related as to produce the results herein described, and the ice withdrew or disappeared so as to lay down the englacial material in a sheet instead of gathering it up into drumlins. Possibly in certain areas drumlins were actually formed and subsequently washed away or otherwise destroyed.

John Millis

THE RELATION BETWEEN PHOTOSYNTHESIS OF CARBON DIOXIDE AND NITRATE REDUCTION

THE first step in the utilization of nitrates for protein synthesis by the plant leaf is no doubt a reduction of the nitrate to the nitrite and finally to ammonia. The rôle played by sunlight in this action has been investigated from several sides. While Schimper tried to demonstrate that it was by means of light only, and in the cell containing chlorophyll, that nitrate reduction takes place, this theory has been somewhat modified by the researches of Zaleski, of Suzuki and especially of Godlewski to the effect that while nitrate reduction and concomitant protein synthesis take place to a much greater extent in the light, these reactions do also take place in the dark.

The writer has found that perfectly sterile aqueous solutions of potassium or calcium nitrate will keep in the dark, even at 95°, indefinitely without forming a trace of nitrite. If, however, a small quantity of colloidal platinum is added, a reduction of the nitrate soon sets in with the formation of nitrites and of ammonia, as made very evident with the Gries's and Nessler's reagent, respectively. This observation is quite in harmony with that of Schoenbein, who noticed a reduction of nitrates by means of juices of certain fungi, confervæ, etc. As most of the common forms of bacteria possess the property, to some extent at least, of reducing nitrates, it is of course very important to exclude all bacteria from the mixture.

That this reaction is brought about by means of hydrogen peroxide I am very much inclined to doubt, for absolutely no reduction takes place in the presence of hydrogen peroxide, with or without colloidal platinum; nor is the reaction in the least inhibited in vacuo. More probable does it appear that the platinum acts as follows, if there is something present to take up the hydrogen formed:[1]

$$Pt + 2H_2O \rightarrow Pt(OH)_2 + 2H.$$

The hydrogen is kept in the active, or nascent, state by the platinum, and reduces the nitrate directly. The platinum hydroxide in turn splits into platinum and hydrogen peroxide; the latter decomposes to water with the liberation of oxygen:

$$Pt(OH)_2 \rightarrow Pt + H_2O_2;\ H_2O_2 \rightarrow H_2O + O.$$

The increased reduction of nitrates and of protein synthesis in the leaf in the light can be understood from the following observations. It was found that the reduction of potassium and calcium nitrates takes place with remarkable ease in the ultra-violet light of the quartz mercury vapor lamp, forming nitrite, ammonia and oxygen. The same action takes place, though more slowly, in the sunlight and even in diffuse or sky light. The action is greatly accelerated by colloidal platinum, though the latter is not necessary. Of special importance is the fact that the reduction of these nitrates results in a decidedly *alkaline* solution.

The theory that formaldehyde is the first product of reduction in the carbon dioxide appropriation has, of late, gained much substantiation. It must be remembered, however, that the next step, the polymerization of formaldehyde to carbohydrates takes place in alkaline solution only. Now while of course it is true that nitrate reduction in the leaf takes place in the dark, it can not be denied that this action is much greater in the light, and, as Schimper has shown, in the neighborhood of the chloroplasts; which must then result in a local alkalinity at these points. Thus not only are the proper conditions for carbohydrate synthesis established. but nitrogen is also produced in the best form and at the most available place for protein synthesis. No other explanation has been given so far as my information goes, and I can conceive no other way in which these very necessary conditions can be produced in the midst, it might be said, of all the acid products of sugar and protein metabolism. In this connection mention might also be made of a micro-chemical observation of MacCallum[2] who found potassium localized in the immediate neighborhood of the chloroplasts.

[1] See Mond and Ramsay, *Zeit. f. phys.-chem.*, **25**, 657. Bredig and von Berneck, *ibid.*, **31**, 254.

[2] *Jour. of Phys.*, **32**, 95, 1905.

But an alkaline area in connection with the chlorophyll can be of even greater importance. It is, in fact, highly probable that the reduction of carbon dioxide itself takes place in an alkaline solution, or better in the form of a bicarbonate. It will be remembered that while in the various attempts of Lieben,[3] Ballo[4] and of Fenton,[5] to reduce carbonic acid by chemical means, formic acid only was produced, the reaction took place either only with the alkaline bicarbonate or it was greatly accelerated by the presence of alkali.

While the experiments of Herchenfinkle,[6] and of Berthelot and Gaudechon[7] on the decomposition of carbon dioxide into carbon monoxide and oxygen in ultra-violet light are a valuable contribution to the chemistry of carbon dioxide, It must be borne in mind that in the plant leaf we are dealing with a substance of very different properties, namely, metacarbonic acid or its salts.

That certain plants are capable of liberating oxygen and synthesizing carbohydrates from solutions of alkaline bicarbonates has been demonstrated by Draper, Hassak, Nathanson, Anglestein[8] and others. These results can not be interpreted to mean that the plant is capable of utilizing the alkaline bicarbonates directly, but as the liberation of oxygen decreases with increasing alkalinity, it is clear from the equation,

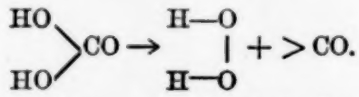
$$NaHCO_3 + HOH \leftrightarrows NaOH + H_2CO_3,$$

that the plant is utilizing the H_2CO_3 formed by hydrolysis of the sodium bicarbonate. As McCoy[9] has shown, the amount of sodium hydroxide present in the above reaction is decreased to about one twentieth of the amount calculated for a normal hydrolysis, because of the secondary reaction:

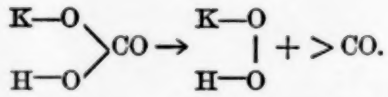
$$NaOH + NaHCO_3 \leftrightarrows H_2O + Na_2CO_3.$$

Thus it is clear that the plant has considerable carbonic acid at its disposal, which it can utilize until the solution becomes too strongly alkaline. It must be noted that from the beginning, the action is taking place in an alkaline medium. Of special importance in this connection are the observations of Klebs[10] and of Hassak[11] who found that various forms of algæ growing in distilled water produce alkalinity therein during active appropriation of carbon dioxide in the sunlight.

In view of these facts, how then can the reduction of carbonic acid be pictured? Nef[12] has suggested that the first step in photosynthesis is as follows:



Now it is highly probable that the degree of dissociation brought about by light is greatly increased in the case of the alkaline bicarbonate:



This decomposition is, of course, similar to the decomposition of carbon dioxide into carbon monoxide and oxygen by means of ultra-violet light studied by Herchenfinkle. The potassium hydrogen peroxide decomposes, reforming potassium hydroxide, and liberating oxygen. The OC< is immediately reduced to formaldehyde by an action analogous to the catalytic reduction of the nitrates as given above:

$$M + 2HOH \rightarrow M(OH)_2 + 2H,$$
$$2H + > CO \rightarrow H_2CO,$$
$$2M(OH)_2 \rightarrow M + 2H_2O + O_2.$$

The detailed steps in the argument have not been fully developed in the above brief notice. Further work along these lines, as well as on the relation between plant acids and protein synthesis, are in progress, and will be published fully elsewhere.

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[3] *Monatsh. f. Chem.*, 1895 and 1897.
[4] *Berl. Ber.*, 1884, 6.
[5] *Jour. Chem. Soc. London*, **91**, 689.
[6] *Compt. rend.*, **149**, 395.
[7] *Ibid.*, **151**.
[8] Dissertation, Halle, 1910.
[9] *Amer. Chem. Jour.*, **29**, 437.
[10] *Unters. Bot. Inst. Tuebingen*, **2**, 340.
[11] *Ibid.*, 465.
[12] *Ann. Chem.* (Liebig), **357**, 253.